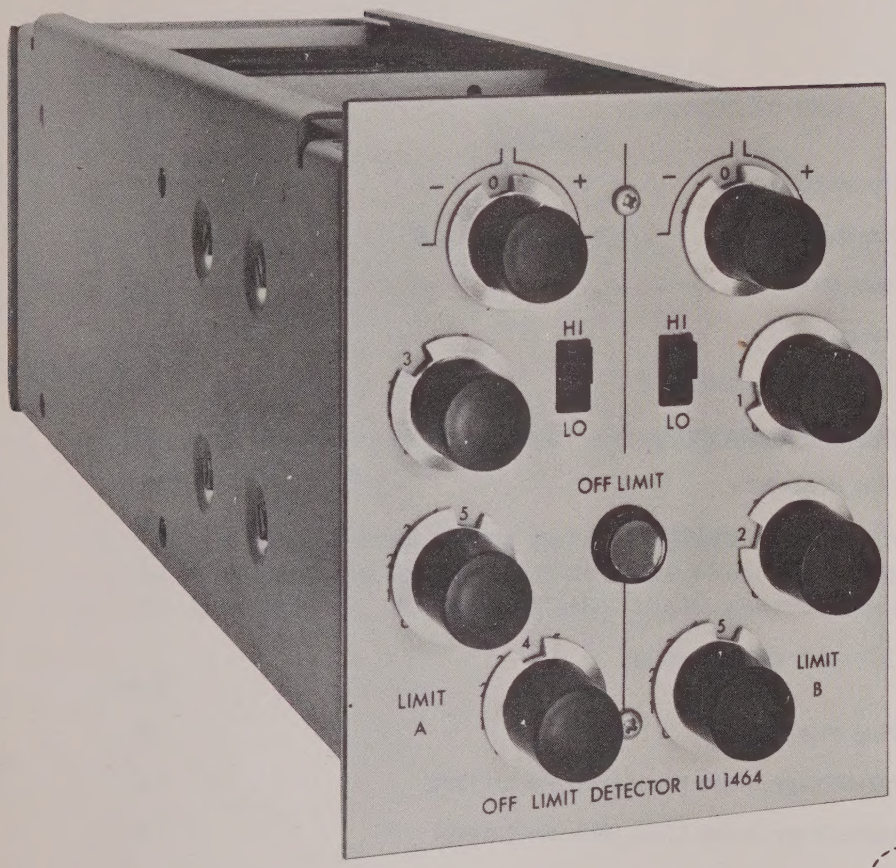
OFF-LIMIT DETECTOR LU 1464



SOLARTRON

SOLARTRON

TECHNICAL MANUAL

MP MASTER
MA24418

LIST OF CONTENTS

Section		Page
1.	Introduction	1
2.	Specification	1
3.	Installation	2
4.	Operation	4
5.	Principles of Operation	5
6.	Technical Description	8
7.	Test Procedure	10
	Components List	12

LIST OF DIAGRAMS

Diagram		Page
1.	Plug PLA Details	2
2.	Block Diagram Off Limit Detector LU 1464	5
3.	Logic Diagram Off Limit Detector LU 1464	7
4.	Control Logic Waveforms for a single channel in an alarm state	9
5.	Component Location LU 1464 Main Unit	13
6.	Component Location Comparator Board (9001)	15
7.	Component Location Comparator Board (9002)	17
8.	Component Location Control Logic Board (9003)	20
9.	Component Location Power Supply Board (9004)	21
10.	Circuit Diagram Sheet 1	Following Page 21
11.	Circuit Diagram Sheet 2	Following Page 21

OFF LIMIT DETECTOR

LU1464

Amendment No. 1.

Page 5.

Amend the paragraph headed "External Alarm Equipment" to read as follows:-

"If an external alarm warning system, e.g. a klaxon, is to be driven by the system, connect the external circuit to pins A, B, C or pins D, E, F, plug PLC at the rear of the unit".

October 1965.

Section 1

INTRODUCTION

The unit monitors signals derived from the system voltmeter and gives a visual indication of alarm when any signal value exceeds or falls below a manually pre-set limit. Simultaneously an alarm indication signal is issued to enable the system output devices to identify the recorded off limit signal. Facilities are also available to drive external alarm annunciating equipment, e.g. a second lamp or klaxon.

The unit has two separate limits, A and B, which may be switched individually to Hi or Lo. One limit may be substitued for the other.

A zone limit may be obtained by arranging that the scanner monitors the same point twice while the detector alternately calls up Hi and Lo limits.

Two off limit detectors may be incorporated in a system, one providing two Hi limits and the other two Lo limits. Two zone limits may now be obtained without the restriction of channel duplication.

Monitoring may be inhibited on unwanted channels.

Section 2

SPECIFICATION

Input:	Signals from the voltmeter conveying numerical and polarity information.
Input Levels:	Signals are in binary coded decimal form:- '1' line = -5V to -13V and '0' line =-2V to +1V.
No. of Limits:	Two. Each may be set to either Hi or Lo.
Limit Change-Over:	By means of relay contact closure in system scanner.
Alarm States:	1. If a Hi limit is selected of value +N, an alarm will be given for any value more positive than N. 2. If a Hi limit is selected of value -N, an alarm will be given for any value more negative than N. 3. If a Lo limit is selected of value +N, an alarm will be given for any value less than +N and for any negative value. 4. If a Lo limit is selected of value -N, an alarm will be given for any value less than -N and for any positive value.
Alarm Indication:	1. Illumination of a front panel lamp and relay contact closure to control external warning equipment, e.g. a klaxon. 2. An output signal to the printer and typewriter.
Alarm Cancel:	When voltmeter digitising is called on the channel following the alarm channel, the alarm output signal to the printer and/or typewriter is cancelled. The visual and audible warnings are cancelled by depression of the illuminated front panel push-button.
Alarm Inhibit:	By means of relay contact closure in the system scanner, via the system pin board.
Power Requirements:	95V to 130V or 190V to 260V, 50-60 c/s, 4VA.
Ambient Temperature:	$0^{o}C$ to $50^{o}C$.
Weight:	4lb. 11oz. (2.1 kg.) approx.

Dimensions (excluding front and rear panel fixtures)	5.25 in. x 4.25 in. x 14 in. (13.3 cm x 10.8 cm x 35.5 cm).

Section 3

INSTALLATION

General

The module is usually supplied as part of a complete system and details of its front panel switch settings and input and output connections will be found in the preliminary sections of the system handbook.

It is also available as a separate item, the general information given below supplying the data required for its use in any special set-up.

Connector Details

Plug PLA

Mains power is applied through fixed plug PLA on the rear panel of the module, the positions of the line, neutral and earth pins being shown in diagram 1. No mains on/off switch is fitted.

Diagram 1. Plug PLA Details

Plug PLB

Inputs from the system Voltmeter, Scanner and Pinboard are routed through this connector. It may also be used to direct the inputs to a second Off Limit Dectector.

Table 1. Plug PLB Details

Pin Designation	Service	Remarks
A, B	Voltmeter Polarity +	-10V
C, D	Voltmeter Polarity -	-10V
E, F	Voltmeter Reading 2^4	Thousands in 21 BCD form
H, J	Voltmeter Reading 1^4	
K, L	Voltmeter Reading 8^3	Hundreds in 8421 BCD form
M, N	Voltmeter Reading 4^3	

Table 1 Plug PLB Details (Cont.)

Pin Designation	Service	Remarks
P, R	Voltmeter Reading 2^3	Hundreds in 8421 BCD form
S, T	Voltmeter Reading 1^3	
U, V	Voltmeter Reading 8^2	Tens in 8421 BCD form
W, X	Voltmeter Reading 4^2	
Y, Z	Voltmeter Reading 2^2	
a, b	Voltmeter Reading 1^2	
c, d	Voltmeter Reading 8^1	Units in 8421 BCD form
e, f	Voltmeter Reading 4^1	
h, j	Voltmeter Reading 2^1	
k, m	Voltmeter Reading 1^1	
n, p	Alarm State Signal	-10V to Printer Drive and/or Typewriter Drive
r, s	End of Conversion Signal	Positive pulse from Digital Voltmeter
t	Alarm Bistable Reset	Positive Pulse from Scanner
u	Inhibit Signal	(Digitise Command pulse to Digital Voltmeter) -12V from Scanner (via system pin board)
v	Limit A Selection Signal	-12V from Scanner (via system pin board)
HH	Common Rail	System connection

Table 2. Plug PLC Details

Pin Designation	Service	Remarks
A	Alarm Relay	N/C Contact 1
B	Alarm Relay	Common Contact 1
C	Alarm Relay	N/O Contact 1
D	Alarm Relay	N/C Contact 2
E	Alarm Relay	Common Contact 2
F	Alarm Relay	N/O Contact 2
W	Common Rail	For external use

Mains Selector Plug

The mains Selector Plug (MSP1) is engraved with 115V and 230V markings and should be adjusted so that the metal pointer at the side of the module is opposite to the marking corresponding to the user's mains voltage.

Mains Fuse

Check that the mains fuse is correctly rated; 1A for 230V supplies and 2A for 115V supplies. The fuseholder is located between MSP1 and PLA.

Mounting Arrangements

The Compact Logger cabinets have been specifically designed to accommodate a number of identical size modules, of which the Off Limit Detector is one. The modules slide into the cabinet space frame along lips on their side panels which act as runners. They are retained by a wing nut at the rear. Interconnecting plugs are free on their loom to avoid connector alignment problems. 50 way connectors, where used, are retained by straight knurled edge screws which must be released to remove the free mating components.

A Mounting Rack, LY1472, is available for housing a maximum of four modules of Off Limit Detector dimensions. It is intended for use in multi-layer systems but can be provided as a separate item.

Section 4

OPERATION

Front Panel Controls

The four digital switches and the Hi/Lo switch on the right hand side of the front panel are identified as LIMIT B switches. The similar group on the left hand side is the set of LIMIT A switches. Situated between them is a combined alarm lamp/push button switch.

The digital switches are adjusted until the reading shown by them is the required off-limit value. Note that the uppermost switch selects the polarity and the most significant figure of the reading and the remaining switches, in descending order, select the remainder of the reading.

Use In A System

The unit may be set up to give an alarm when any one of the following deviations takes place.

(a) A positive voltmeter reading (i) exceeds a pre-set positive limit or (ii) falls below that limit or becomes negative.
(b) A negative voltmeter reading (i) exceeds a pre-set negative limit or (ii) falls below that limit or becomes positive.

To set up the unit to indicate an alarm in the case of (a) select the positive reading on the switches and in (a) (i) set the Hi/Lo switch to Hi and in (a) (ii) set the Hi/Lo switch to Lo. In the case of (b) select the negative reading on the switches and in (b) (i) set the Hi/Lo switch to Hi and in (b) (ii) set the Hi/Lo switch to Lo.

To Obtain a Zone Limit

When only one unit is available, it is necessary to set both LIMIT A and LIMIT B switches to the required values and compare the value of the input signal, connected in parallel to two successive scanner channels, with those shown on the sets of the switches.

When two units are available, two zone limits may be obtained by arranging that the two sets of LIMIT B switches (one to Hi and one to Lo) monitor one channel and that the two sets of LIMIT A switches (one to Hi and one to Lo) monitor a second channel.

External Alarm Equipment

If an external alarm warning system e.g. a klaxon, is to be driven by the system, connect the external circuit to pins B and C or E and F, plug PLC at the rear of the unit. The pairs of pins are linked by relay operation when an alarm occurs.

Alarm Cancellation

The switch situated below the two Hi/Lo switches is illuminated when an alarm occurs. Depression of the switch will reset it and also cancel any other visual or any audible alarm annunciation. The input source causing the alarm may be determined from an inspection of the printer and/or typewriter records.

Section 5

PRINCIPLES OF OPERATION

Basic Principles (Diagram 2)

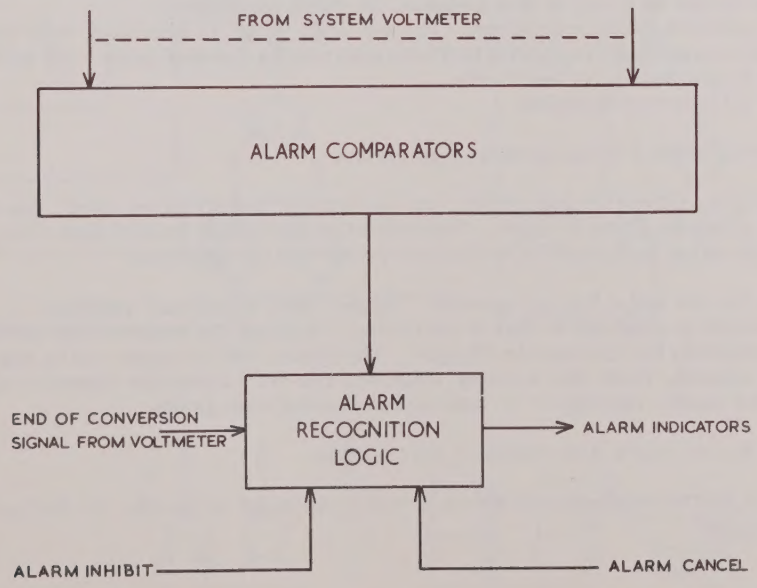


Diagram 2. Block Diagram Off Limit Detector LU1464

Voltmeter readings are applied to alarm comparator circuits, which give an output whenever the applied reading deviates from a selected value.

Comparator outputs, when present, are gated with 'end of conversion' signals from the system voltmeter, and alarm indicator circuits are actuated. Alarm cancel and inhibit facilities are provided.

Logic Description (Diagram 3)

BCD information signals from a system voltmeter, e.g. LM1420, are applied in parallel to groups of diode gates which form the comparator stages of the module. The information is presented continuously, but is read for only ten milliseconds after each voltmeter conversion.

Although the off limit condition is detected as a parallel operation, the logic of the module is more readily understood if the gates are considered to act in a serial fashion.

Hi Limit Detection

Assume that the circuitry has been set to detect a Hi limit. If the polarity of the monitored signal agrees with the set polarity, either G1 or G2 (diagram 3) will open G3. The OR gate will thus supply one input to G4 and one input to G5. Group G4 to G7 inclusive compares the voltmeter 2^4 output (the most significant BCD figure of the thousands stage of the LM1420) with the set 2 limit of the most significant stage of the module.

The comparison can produce one of four possible results.

(a) A 2 is set and a 2 is present - inspect less significant numbers.

In this case G4 gives an output, the 2^4 and polarity signals being present. G5 and G6 are closed, no input being provided from the set 2 limit line when set 2 is selected. Thus, there is no alarm output from G6.
The output from G4, however, causes G7 to enable the gating for the next most significant input (1^4).
Inspection of this second group and succeeding groups of gates will take place until either
i) All gates have been sampled, i.e. the set numbers and the input are identical. No alarm will be given in this instance, Hi being monitored.
ii) Or an alarm state is detected. The set limit input, in this case, will supply a second input to a gate corresponding to G6 in a lower order group of gates. G6 will then operate G8 to give an alarm indication.
iii) Or (b) below is sampled.

(b) A 2 is set and a 2 is not present - no alarm.

In this case, G5 and G6 are closed, the set 2 limit line giving no input. G4 is also closed by the absence of the 2^4 input. Consequently, there will be no output from G7 and gates corresponding to G4 and G5 in the next group will be inhibited.

(c) A 2 is not set and a 2 is not present - inspect less significant numbers.
The result is identical to that of (a) above, requiring the examination of further stages. G4 is closed by the absence of a 2^4 input. Therefore, G6 is closed and no alarm is called. G5 is opened, from the polarity stage and the set 2 limit line (absence of a set 2 limit gives an input), causing G7 to open and prime the next group.

(d) A 2 is not set and a 2 is present - alarm state.

G4, G5 and G6 are open and an alarm output is given by G6 to G8. No further examination is required.

Lo Limit Detection

The actions of the comparator gates are identical to those carried out when a Hi limit is being

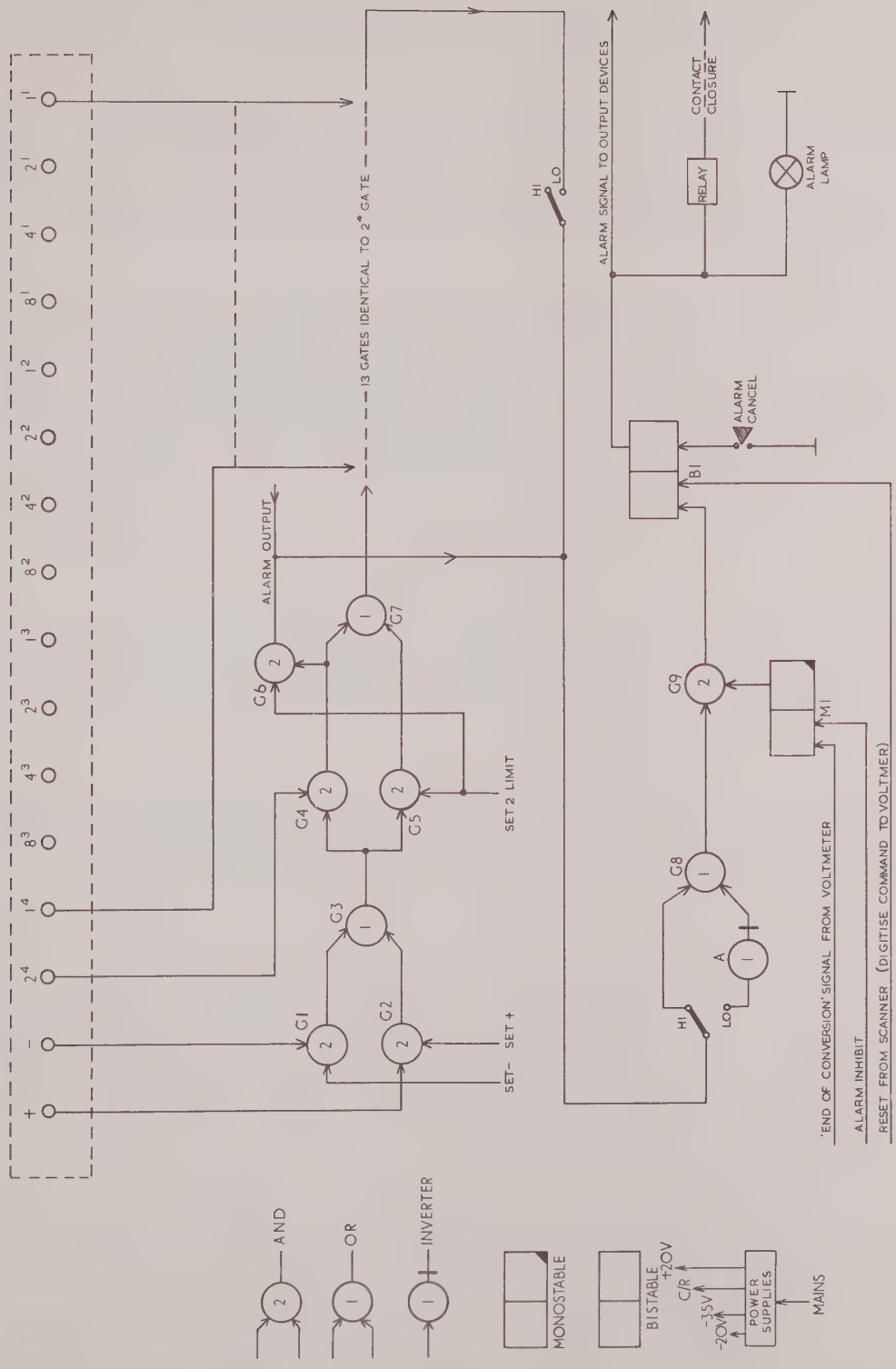


Diagram 3. Logic Diagram Off Limit Detector LU1464

examined but the effect of an alarm gate output is reversed.

An alarm gate is opened when the voltmeter reading is greater than the set number. The alarm gate output is taken to inverter A, causing G8 to remain closed. As a result, no alarm is called.

If no alarm gates are opened, the voltmeter reading is lower than the set number. The absence of an alarm gate output allows inverter A to supply an input to G8 and an alarm is called.

For the unique case of an identical input and set number, an output is given by the gating of the least significant (1^1) gate. This is applied to inverter A, causing G8 to remain closed.

Alarm Recognition

When the comparators recognise an alarm state, G8 supplies one input to G9. Multivibrator M1, when fired by the 'end of conversion' pulse from the system voltmeter, supplies a second input to G9, for a 10 msec. period. G9 output turns over bistable B1 which operates alarm indictors.

The bistable may be reset by either the next digitise command pulse from the system scanner to the voltmeter or by depressing a manual alarm cancel push button.

The monostable may be inhibited from a system pinboard if alarm detection is not required.

Section 6

TECHNICAL DESCRIPTION

Introduction

Circuit diagrams of the module are included at the rear of this manual. It will be noted that the printed circuit boards shown on the diagrams are identified by the letters A to E inclusive. Throughout this description, any reference to individual components on a board will be followed by the letter of the board. For example, MR23 on board E will be shown as MR23 (E).

Comparator Stages

The stages comprise one group of polarity gates and fourteen identical groups of digital gates on boards B, C, D and E1. MR1 to MR4 and R1 to R4 (E1) form the polarity gates. A typical digital gate, that monitoring the 2^4 input from the voltmeter, consists of MR5 to MR11 and R5 to R8 (E1).

(a) Limit Selection

Energising voltages are supplied to the gates through banks of switches connected to the -20V rail via relay contact RLB3. The settings of the switches are such that for any number selected on the front panel of the unit, its BCD equivalent is applied to the group of gates associated with the switch. Switch wafers are open when binary '1' is set and closed when binary '0' is set. Relay RLB is normally operated, directing the -20V supply to switches SH, SJ, SK and SL to select Limit B. Limit A is selected when the relay is de-energised by a -12V signal applied to the base of VT9 (E2).

(b) Gate Inputs and Outputs

Polarity and digital information from the system voltmeter is applied to the module through plug PLB. It is compared with a selected limit by the gating stages in the manner discussed in the Logic Description,

(c) Alarm Outputs

These are taken from switches connected to relay contacts RLB2 and RLB4.

Comparing the logic diagram with the circuit diagram, it will be noted that:-

G1 = MR2, SD/3F or SH/3F:	G4 = MR5, MR6
G2 = MR1, SD/3F or SH/3F:	G5 = MR7, SD/1F or SH/1F
G3 = MR3, MR4 :	G6 = MR8, SD/1R or MR9, SH/1R
G7 = MR17,	MR18

A complete interpretation of the circuit may now be made in conjunction with the logic description.

The gating circuits are arranged in groups of four. The first gate of a group draws 1mA , and provides an output to supply the second gate which takes 300μA. An emitter follower is then used to boost the current to gate number three, which again takes 1mA and is followed by the 300μA gate number four.

At this point voltage tolerances become critical and a shaping amplifier is used to restore the voltage levels. This pattern is repeated four times for the complete unit.

Within each gate there are two series diodes conducting in opposite directions at a low current level and the voltage drop is limited to ±0.2 volts per gate, giving a total of ±0.8 volts for a group of four gates. The emitter follower and the shaping amplifier have equal and opposite offset voltages giving a total error of ±0.15 volts. Thus, the total voltage variation can be ±1 volt on the nominal 3.5 volt supply allowing the inputs to be -2.5 volts for a '0' and -4.5 volts for a '1'.

Control Logic (Diagram 4)

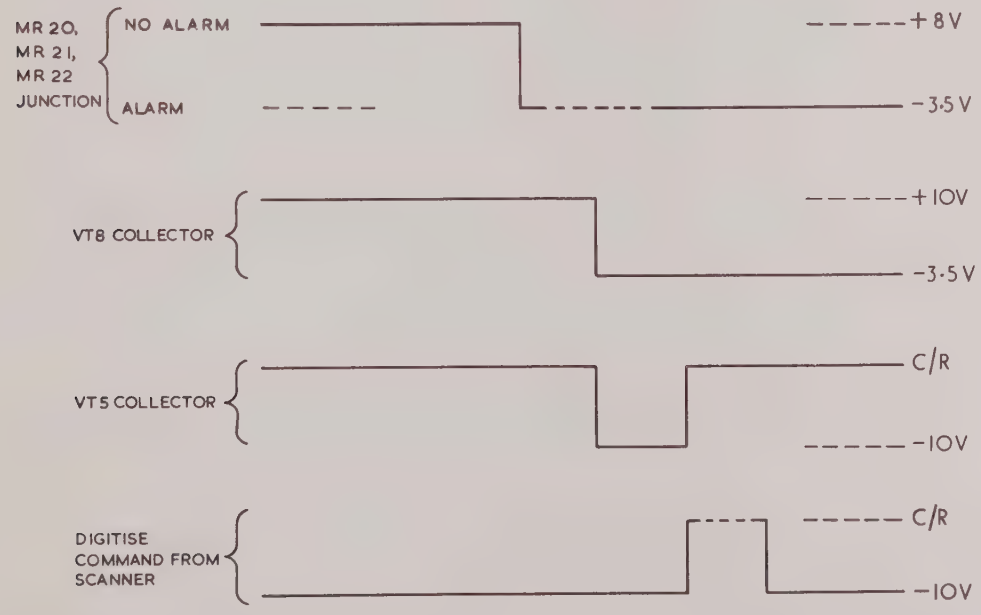


Diagram 4. Control Logic Waveforms for a Single Channel in an alarm state

Alarm outputs from the comparator stages pass through RLB2 to the alarm amplifier VT2 (E2). In the case of a Hi alarm, a positive signal drives VT3 (E2) into conduction, thereby removing a positive clamping potential from the junction of MR22, MR24 (E2). In the case of a Lo alarm, a negative output from VT2 (E2) produces the same effect through MR20 (E2).

At the end of each conversion, the voltmeter issues a signal which is used to fire monostable VT7, VT8 (E2). Thus, if an alarm state exists, alarm bistable VT4, VT5 (E2) turns over and

issues a negative signal to pin n, PLB. An alarm state will now be recorded by the system output devices. The bistable also operates RLA through inverter VT6. Contact closure causes illumination of lamp ILP1 by means of a secondary winding on mains transformer T1. Also, pins B, C and F, E, PLC are linked for external alarm annunciation purposes. The bistable is reset by the next digitise command pulse from the system scanner or by depression of SA. The relay, however, remains operated through latching contact RLA1 until push button SA is depressed. Bistable turn-over may be prevented on any or all channels by inhibiting the monostable via pin u, PLB.

Power Supplies

A mains transformer T1 with two primary windings is used. These may be connected in series or in parallel by means of the mains selector plug to give 230V or 115V working.

A 14.5-0-14.5V secondary is applied to two full wave rectifiers and smoothed to give nominal +20V d.c. and -20V d.c. supplies.

A 6V secondary is full wave rectified and smoothed to give a nominal -3.5V d.c. supply.

Section 7

TEST PROCEDURE

Introduction

The procedure given in this section is basically the production test to which all units are subjected prior to despatch. It is provided to enable the user to confirm the performance of the unit and to make any necessary adjustments.

Equipment

(a) Multi-Range Test Meter, 20000Ω/V
(b) Oscilloscope - Solartron CD 1220
(c) Digital Voltmeter LM1420 or similar
(d) It is assumed that the module is incorporated in a Compact Logger system.

Access

Release the free connectors and remove the wing nut at the rear of the module. Ease the module out of its cabinet and position it on the bench in such a way that the free connectors which were attached to it may be re-attached through extension leads. A 50-way socket, compatible with the free and fixed connectors and linked together by insulated leads about 3ft. long in a 'one-to-one' pin arrangement, will be suitable for signal coupling. A three-lead cable with suitable connectors will be required for the power supply.

Release the two holding screws on the right-hand side panel of the module (viewed from the front) and lower the panel. The printed circuit boards may now be hinged out for servicing.

Initial Checks

(a) Ensure that the mains selector plug is set to the correct voltage tapping. Connect the unit to the mains supply and switch on.

(b) On power supply board A (14649004) check the following supplies with respect to pin 6 of T1.

(i) At pin 1, the -20V supply should be within the limits ±2V.
(ii) At pin 3, the +20V supply should be within the limits ±2V.
(iii) At pin 7, the -3.5V supply should be within the limits ±0.35V.

Note that all tolerances should be in the same direction and of the same percentage order. For example, +22V, -22V and -3.8V are acceptable; +22V, -18V and -3.2V are not acceptable.

Test Sequence

(a) Connect the digital voltmeter to the junction of MR20, MR21, MR22 and R33 on board E (14649003). This is the rearmost board of the module.

(b) Set the limit B front panel switches to +0000 and Hi. The digital voltmeter should read approximately +7V to +8V with a zero input to the module.

(c) Increase the input to the module to 0001. The digital voltmeter reading should fall to approximately -3.5V.

(d) Adjust the limit B switches to 0001. The digital voltmeter reading should return to +7V to +8V.

(e) Repeat (c) and (d), alternately increasing the input to the module and the reading of the limit B switches by one digit, on the units stage. Carry out the same tests for the remaining stages.

(f) Repeat (b) to (e) with negative inputs and switch settings.

(g) Apply -12V to pin v on plug PLB. This action calls up limit A and cancels limit B. limit B. Repeat (b) to (f).
The -12V signal will normally be derived from a system pin board.

(h) Set limits A and B to Lo and repeat (b) to (g).

(j) Connect the testmeter to pin 34, board E2.
The pin should be at approximately common rail potential. Set up an alarm state on any convenient channel. When the system voltmeter completes its conversion of the channel sample, the meter reading should fall to approximately -10V and the alarm lamp should be illuminated. At the commencement of the next channel sampling period, the meter reading should return to common rail potential while the alarm lamp remains illuminated. Depress the front panel push button. The light should extinguish.

(k) Apply -12V to pin u on plug PLB and check that the alarm indicator circuits are inhibited. The -12V will normally be derived from a system pin board.

(l) Check the alarm annunciator pins on plug PLC for required continuity in both alarm and no-alarm states.

COMPONENTS LIST

for

OFF LIMIT DETECTOR LU1464

MAIN UNIT

PRINTED CIRCUIT BOARDS

Description	Solartron Part No.
Comparator Board	1464 9001
Comparator Board	1464 9002
Control Logic Board	1464 9003
Power Board	1464 9004

CAPACITORS

Circuit Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No.	Manufacturer & Type	
C1	1000	-20 +100	25	2607 91000	Hunts	MEF 109 AT
C2	1000	-20 +100	25	2607 91000	Hunts	MEF 109 AT
C3	1000	-20 +100	25	2607 91000	Hunts	MEF 109 AT

SEMICONDUCTORS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Diode	3005 20070	Mullard	OA91
MR2	Diode	3005 20070	Mullard	OA91

MISCELLANEOUS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
PLA	Plug, 3-way	3523 03030	Bulgin	P429
PLB	Plug, 50-way	3529 50010	Amp	M
PLC	Plug, 20-way	3529 20010	Amp	M
SA	Switch, Illuminated Push Button	3775 00020	T.M.C.	
SB	Switch, Slide	3750 00240	Arcelectric	T225
SC	Switch, Slide	3750 00240	Arcelectric	T225
SD	Switch, Wafer	3701 00420	N.S.F.	A
SE	Switch, Wafer	3701 00430	N.S.F.	A
SF	Switch, Wafer	3701 00430	N.S.F.	A
SG	Switch, Wafer	3701 00430	N.S.F.	A
SH	Switch, Wafer	3701 00420	N.S.F.	A
SJ	Switch, Wafer	3701 00430	N.S.F.	A
SK	Switch, Wafer	3701 00430	N.S.F.	A
SL	Switch, Wafer	3701 00430	N.S.F.	A

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
RLA	Relay	3006 50410	Oliver Pell Controls Ltd.	VP4 CAB-26
RLB	Relay	3006 50410	Oliver Pell Controls Ltd.	VP4 CAB-26
ILP1	Lamp	3007 10180	Hivac No. 2	6V Grey
FS1	Fuse 500mA	3601 01280	Belling & Lee	L562/500*
T1	Transformer	3010 50240		Open C-Core
MSP1	Mains Supply Panel	3990 00060	McMurdo	BMVS/A/4/02

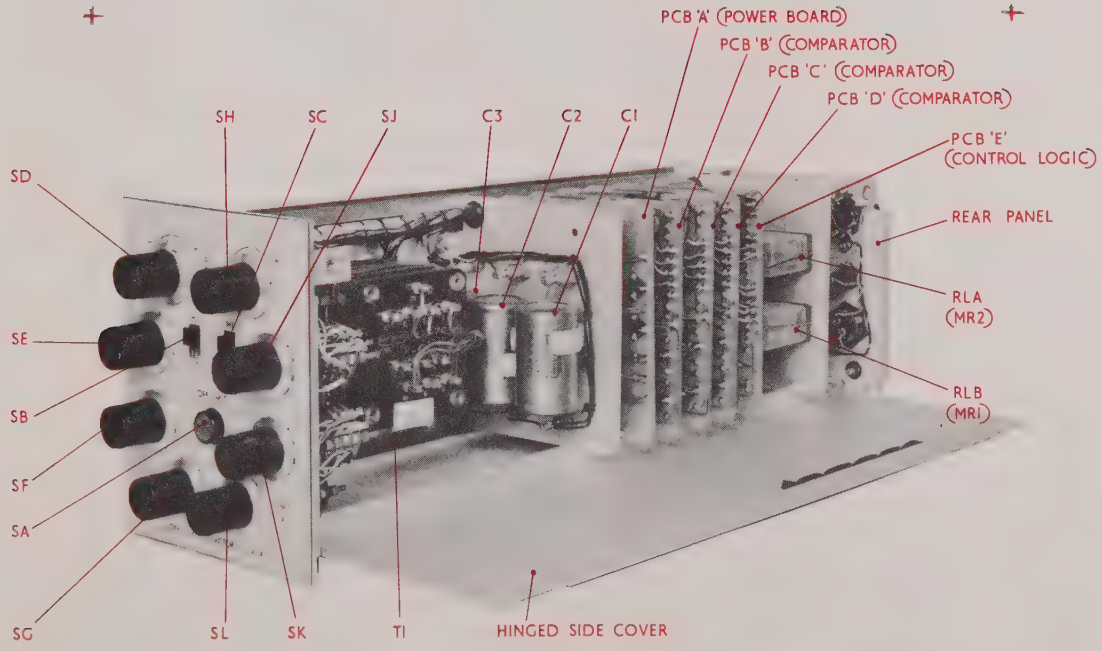


Diagram 5. Component Location LU 1464 Main Unit.

COMPONENTS LIST

for

PRINTED CIRCUIT BOARD 1464 9001

COMPARATOR BOARD

RESISTORS

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R1	39k	10	$\frac{1}{4}$	1723 43900	Dubilier	BTT Carbon
R2	68k	10	$\frac{1}{4}$	1723 46800	Dubilier	BTT Carbon
R3	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R4	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R5	330k	10	$\frac{1}{4}$	1723 53300	Dubilier	BTT Carbon
R6	330k	10	$\frac{1}{4}$	1723 53300	Dubilier	BTT Carbon
R7	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R8	33k	10	$\frac{1}{4}$	1723 43300	Dubilier	BTT Carbon
R9	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R10	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R11	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R12	39k	10	$\frac{1}{4}$	1723 43900	Dubilier	BTT Carbon
R13	68k	10	$\frac{1}{4}$	1723 46800	Dubilier	BTT Carbon
R14	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R15	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R16	470k	10	$\frac{1}{4}$	1723 54700	Dubilier	BTT Carbon
R17	8.2k	10	$\frac{1}{4}$	1723 38200	Dubilier	BTT Carbon
R18	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R19	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R20	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon

SEMICONDUCTORS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Diode	3005 20070	Mullard	OA91
MR2	Diode	3005 20070	Mullard	OA91
MR3	Diode	3005 20070	Mullard	OA91
MR4	Diode	3005 20720	Mullard	OA200
MR5	Diode	3005 20720	Mullard	OA200
MR6	Diode	3005 20070	Mullard	OA91
MR7	Diode	3005 20070	Mullard	OA91
MR8	Diode	3005 20070	Mullard	OA91
MR9	Diode	3005 20070	Mullard	OA91
MR10	Diode	3005 20070	Mullard	OA91
MR11	Diode	3005 20720	Mullard	OA200
MR12	Diode	3005 20720	Mullard	OA200
MR13	Diode	3005 20070	Mullard	OA91
MR14	Diode	3005 20070	Mullard	OA91
MR15	Diode	3005 20070	Mullard	OA91

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR16	Diode	3005 20070	Mullard	OA91
MR17	Diode	3005 20070	Mullard	OA91
MR18	Diode	3005 20720	Mullard	OA200
MR19	Diode	3005 20720	Mullard	OA200
MR20	Diode	3005 20070	Mullard	OA91
MR21	Diode	3005 20070	Mullard	OA91
MR22	Diode	3005 20070	Mullard	OA91
MR23	Diode	3005 20070	Mullard	OA91
MR24	Diode	3005 20070	Mullard	OA91
MR25	Diode	3005 20720	Mullard	OA200
MR26	Diode	3005 20720	Mullard	OA200
MR27	Diode	3005 20070	Mullard	OA91
MR28	Diode	3005 20070	Mullard	OA91
VT1	Transistor	3005 50450	Texas	2N 1302
VT2	Transistor	3005 51560	Newmarket	NKT 224
VT3	Transistor	3005 51560	Newmarket	NKT 224

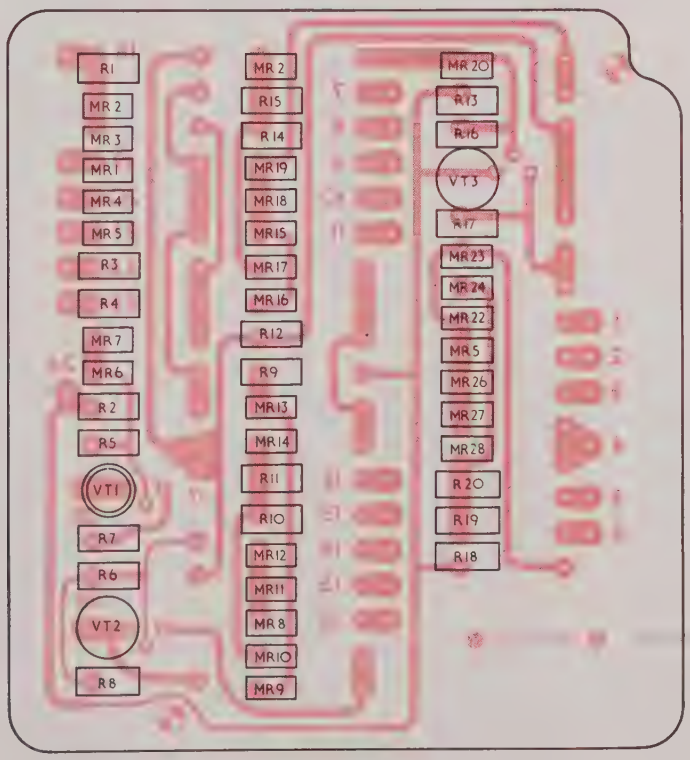


Diagram 6. Component Location Comparator Board (9001)

COMPONENTS LIST

for

PRINTED CIRCUIT BOARD 1464 9002

COMPARATOR BOARD

RESISTORS

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R1	39k	10	$\frac{1}{4}$	1723 43900	Dubilier	BTT Carbon
R2	68k	10	$\frac{1}{4}$	1723 46800	Dubilier	BTT Carbon
R3	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R4	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R5	330k	10	$\frac{1}{4}$	1723 53300	Dubilier	BTT Carbon
R6	330k	10	$\frac{1}{4}$	1723 53300	Dubilier	BTT Carbon
R7	10k	10	$\frac{1}{4}$	1723 11000	Dubilier	BTT Carbon
R8	33k	10	$\frac{1}{4}$	1723 43300	Dubilier	BTT Carbon
R9	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R10	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R11	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R12	39k	10	$\frac{1}{4}$	1723 43900	Dubilier	BTT Carbon
R13	68k	10	$\frac{1}{4}$	1723 46500	Dubilier	BTT Carbon
R14	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R15	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R16	170k	10	$\frac{1}{4}$	1723 54700	Dubilier	BTT Carbon
R17	8.2k	10	$\frac{1}{4}$	1723 38200	Dubilier	BTT Carbon
R18	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R19	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R20	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon

SEMICONDUCTORS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Diode	3005 20070	Mullard	OA91
MR2	Diode	3005 20070	Mullard	OA91
MR3	Diode	3005 20070	Mullard	OA91
MR4	Diode	3005 20720	Mullard	OA200
MR5	Diode	3005 20720	Mullard	OA200
MR6	Diode	3005 20070	Mullard	OA91
MR7	Diode	3005 20070	Mullard	OA91
MR8	Diode	3005 20070	Mullard	OA91
MR9	Diode	3005 20070	Mullard	OA91
MR10	Diode	3005 20070	Mullard	OA91
MR11	Diode	3005 20720	Mullard	OA200
MR12	Diode	3005 20720	Mullard	OA200
MR13	Diode	3005 20070	Mullard	OA91
MR14	Diode	3005 20070	Mullard	OA91
MR15	Diode	3005 20070	Mullard	OA91

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR16	Diode	3005 20070	Mullard	OA91
MR17	Diode	3005 20070	Mullard	OA91
MR18	Diode	3005 20720	Mullard	OA200
MR19	Diode	3005 20720	Mullard	OA200
MR20	Diode	3005 20070	Mullard	OA91
MR21	Diode	3005 20070	Mullard	OA91
MR22	Diode	3005 20070	Mullard	OA91
MR23	Diode	3005 20070	Mullard	OA91
MR24	Diode	3005 20070	Mullard	OA91
MR25	Diode	3005 20720	Mullard	OA200
MR26	Diode	3005 20720	Mullard	OA200
MR27	Diode	3005 20070	Mullard	OA91
MR28	Diode	3005 20070	Mullard	OA91
VT1	Transistor	3005 50450	Texas	2N 1302
VT2	Transistor	3005 511560	Newmarket	NKT 224
VT3	Transistor	3005 511560	Newmarket	NKT 224

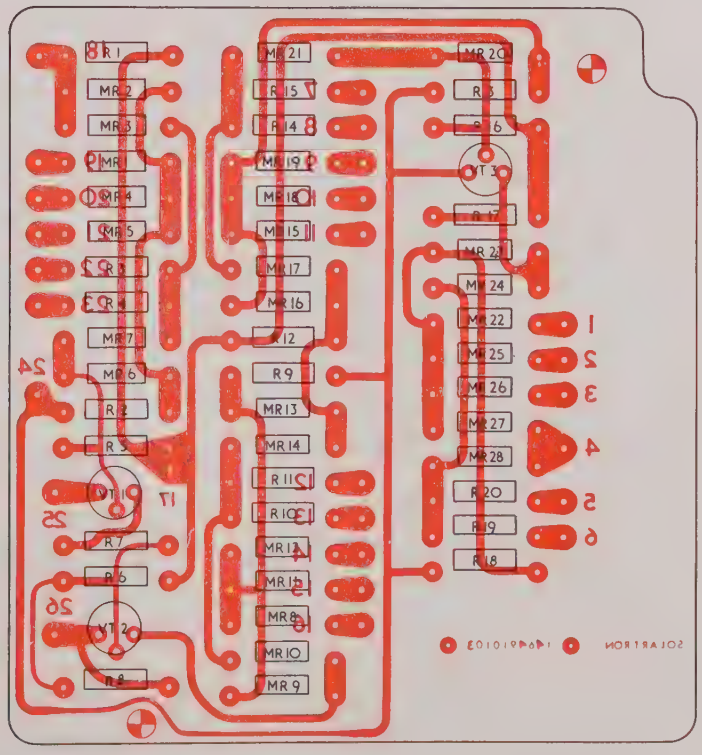


Diagram 7. Component Location Comparator Board (9002)

COMPONENTS LIST

for

PRINTED CIRCUIT BOARD 1464 9003

CONTROL LOGIC BOARD

RESISTORS

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R1	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R2	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R3	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R4	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R5	39k	10	$\frac{1}{4}$	1723 43900	Dubilier	BTT Carbon
R6	68k	10	$\frac{1}{4}$	1723 46800	Dubilier	BTT Carbon
R7	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R8	100k	10	$\frac{1}{4}$	1723 51000	Dubilier	BTT Carbon
R9	470k	10	$\frac{1}{4}$	1723 54700	Dubilier	BTT Carbon
R10	8.2k	10	$\frac{1}{4}$	1723 38200	Dubilier	BTT Carbon
R11	18k	10	$\frac{1}{4}$	1723 41800	Dubilier	BTT Carbon
R12	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R13	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R14	150k	10	$\frac{1}{4}$	1723 51500	Dubilier	BTT Carbon
R15	470k	10	$\frac{1}{4}$	1723 54700	Dubilier	BTT Carbon
R16	22k	10	$\frac{1}{4}$	1723 42200	Dubilier	BTT Carbon
R17	56k	10	$\frac{1}{4}$	1723 45600	Dubilier	BTT Carbon
R18	15k	10	$\frac{1}{4}$	1723 41500	Dubilier	BTT Carbon
R19	180k	10	$\frac{1}{4}$	1723 51800	Dubilier	BTT Carbon
R20	33k	10	$\frac{1}{4}$	1723 43300	Dubilier	BTT Carbon
R21	47k	10	$\frac{1}{4}$	1723 44700	Dubilier	BTT Carbon
R22	3.3k	10	$\frac{1}{4}$	1723 33300	Dubilier	BTT Carbon
R23	1.5k	10	$\frac{1}{4}$	1723 31500	Dubilier	BTT Carbon
R24	2.7k	10	$\frac{1}{4}$	1723 32700	Dubilier	BTT Carbon
R25	330k	10	$\frac{1}{4}$	1723 53300	Dubilier	BTT Carbon
R26	27k	10	$\frac{1}{4}$	1723 42700	Dubilier	BTT Carbon
R27	Not fitted					
R28	330k	10	$\frac{1}{4}$	1723 53300	Dubilier	BTT Carbon
R29	27k	10	$\frac{1}{4}$	1723 42700	Dubilier	BTT Carbon
R30	2.7k	10	$\frac{1}{4}$	1723 32700	Dubilier	BTT Carbon
R31	150k	10	$\frac{1}{4}$	1723 51500	Dubilier	BTT Carbon
R32	15k	10	$\frac{1}{4}$	1723 41500	Dubilier	BTT Carbon
R33	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R34	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R35	68k	10	$\frac{1}{4}$	1723 46800	Dubilier	BTT Carbon
R36	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R37	56k	10	$\frac{1}{4}$	1723 45600	Dubilier	BTT Carbon
R38	220k	10	$\frac{1}{4}$	1723 52?00	Dubilier	BTT Carbon
R39	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R40	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon

PCB 1464 9003/Cont'd

Circuit Ref.	Value Ohms	Tol. %	Rating Watts	Solartron Part No.	Manufacturer & Type	
R41	10k	10	$\frac{1}{4}$	1723 41000	Dubilier	BTT Carbon
R42	27k	10	$\frac{1}{4}$	1723 42700	Dubilier	BTT Carbon
R43	220k	10	$\frac{1}{4}$	1723 52200	Dubilier	BTT Carbon

CAPACITORS

Circuit Ref.	Value µF	Tol. %	Rating Volts	Solartron Part No	Manufacturer & Type	
C1	0.047	10	125	2213 44700	Waycom	Wima Tropyfol F
C2	0.01	10	125	2213 41000	Waycom	Wima Tropyfol F
C3	0.47	10	125	2?03 54700	Waycom	Wima Tropyfol M

SEMICONDUCTORS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Diode	3005 20070	Mullard	OA91
MR2	Diode	3005 20070	Mullard	OA91
MR3	Diode	3005 20070	Mullard	OA91
MR4	Diode	3005 20070	Mullard	OA91
MR5	Diode	3005 20070	Mullard	OA91
MR6	Diode	3005 20070	Mullard	OA91
MR7	Diode	3005 20070	Mullard	OA91
MR8	Diode	3005 20720	Mullard	OA200
MR9	Diode	3005 20720	Mullard	OA200
MR10	Diode	3005 20070	Mullard	OA91
MR11	Diode	3005 20070	Mullard	OA91
MR12	Diode	3005 20070	Mullard	OA91
MR13	Diode	3005 20070	Mullard	OA91
MR14	Diode	3005 20070	Mullard	OA91
MR15	Diode	3005 20720	Mullard	OA200
MR16	Diode	3005 20720	Mullard	OA200
MR17	Diode	3005 20070	Mullard	OA91
MR18	Diode	3005 20070	Mullard	OA91
MR19	Diode	3005 20720	Mullard	OA200
MR20	Diode	3005 20070	Mullard	OA91
MR21	Diode	3005 20070	Mullard	OA91
MR22	Diode	3005 20070	Mullard	OA91
MR23	Diode	3005 20070	Mullard	OA91
MR24	Diode	3005 20070	Mullard	OA91
MR25	Diode	3005 20070	Mullard	OA91
MR26	Diode	3005 20070	Mullard	OA91
MR27	Diode	3005 20070	Mullard	OA91
MR28	Diode	3005 20070	Mullard	OA91

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
VT1	Transistor	3005 51560	Newmarket	NKT 224
VT2	Transistor	3005 50450	Texas	2N 1302
VT3	Transistor	3005 50450	Texas	2N 1302
VT4	Transistor	3005 51560	Newmarket	NKT 224
VT5	Transistor	3005 51560	Newmarket	NKT 224
VT6	Transistor	3005 51560	Newmarket	NKT 224
VT7	Transistor	3005 50450	Texas	2N 1302
VT8	Transistor	3005 50450	Texas	2N 1302
VT9	Transistor	3005 50880	Texas	2N 1304

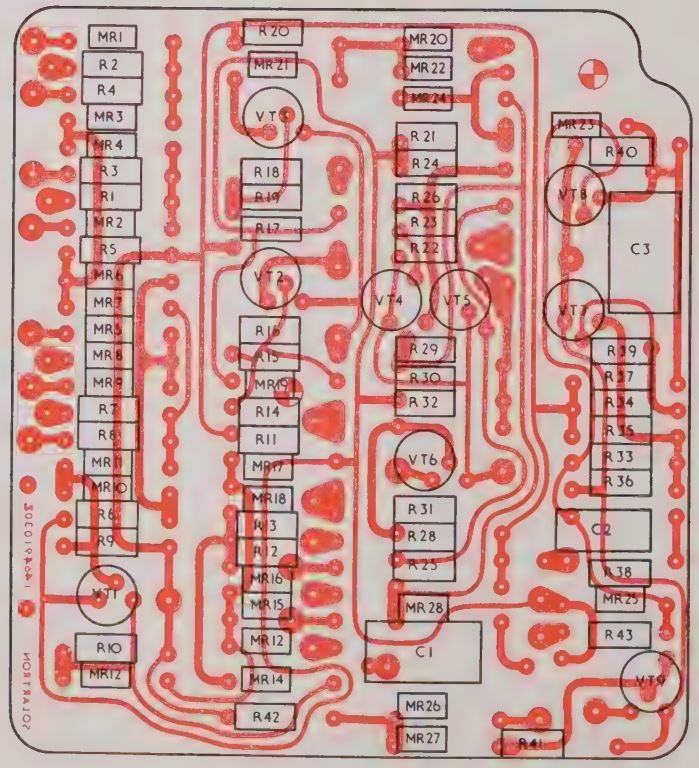


Diagram 8. Component Location Control Logic Board (9003).

COMPONENTS LIST

for

PRINTED CIRCUIT BOARD 1464 9004

POWER BOARD

SEMICONDUCTORS

Circuit Ref.	Description	Solartron Part No.	Manufacturer & Type	
MR1	Diode	3005 21110	Ferranti	ZS70
MR2	Diode	3005 21110	Ferranti	ZS70
MR3	Diode	3005 21110	Ferranti	ZS70
MR4	Diode	3005 21110	Ferranti	ZS70
MR5	Diode	3005 21110	Ferranti	ZS70
MR6	Diode	3005 21110	Ferranti	ZS70

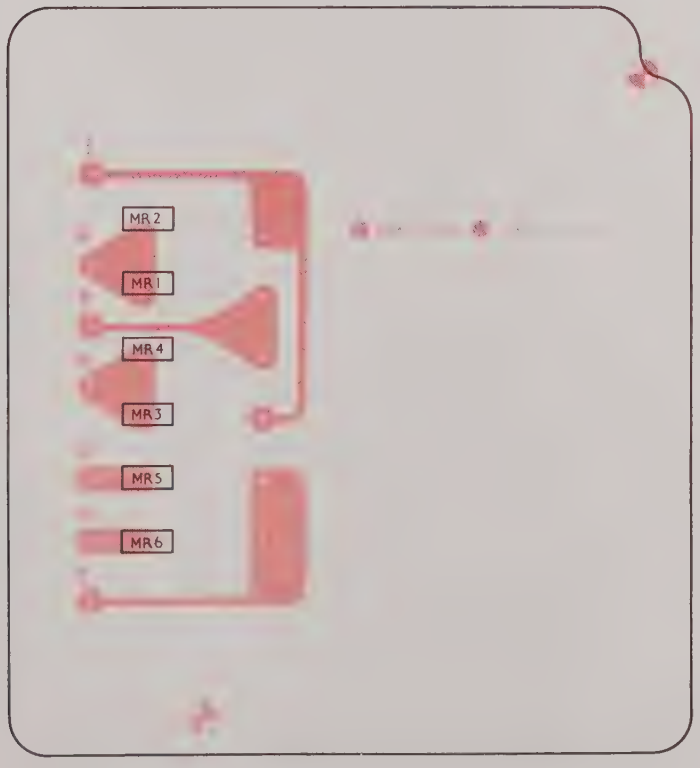
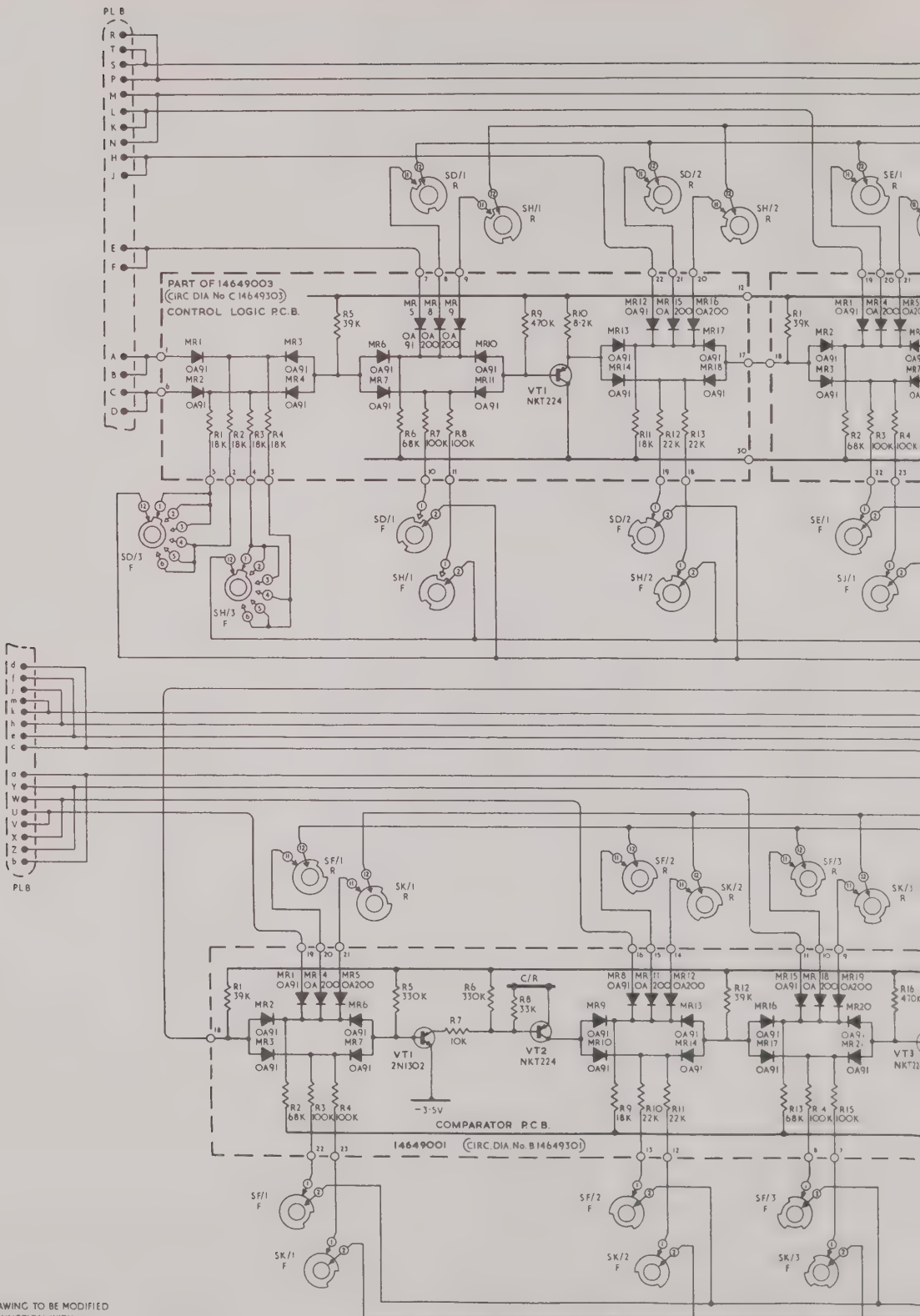


Diagram 9. Component Location Power Board.



THIS DRAWING TO BE MODIFIED IN CONJUNCTION WITH -

B 14649301
B 14649302
C 14649303

} WHICHEVER IS APPLICABLE

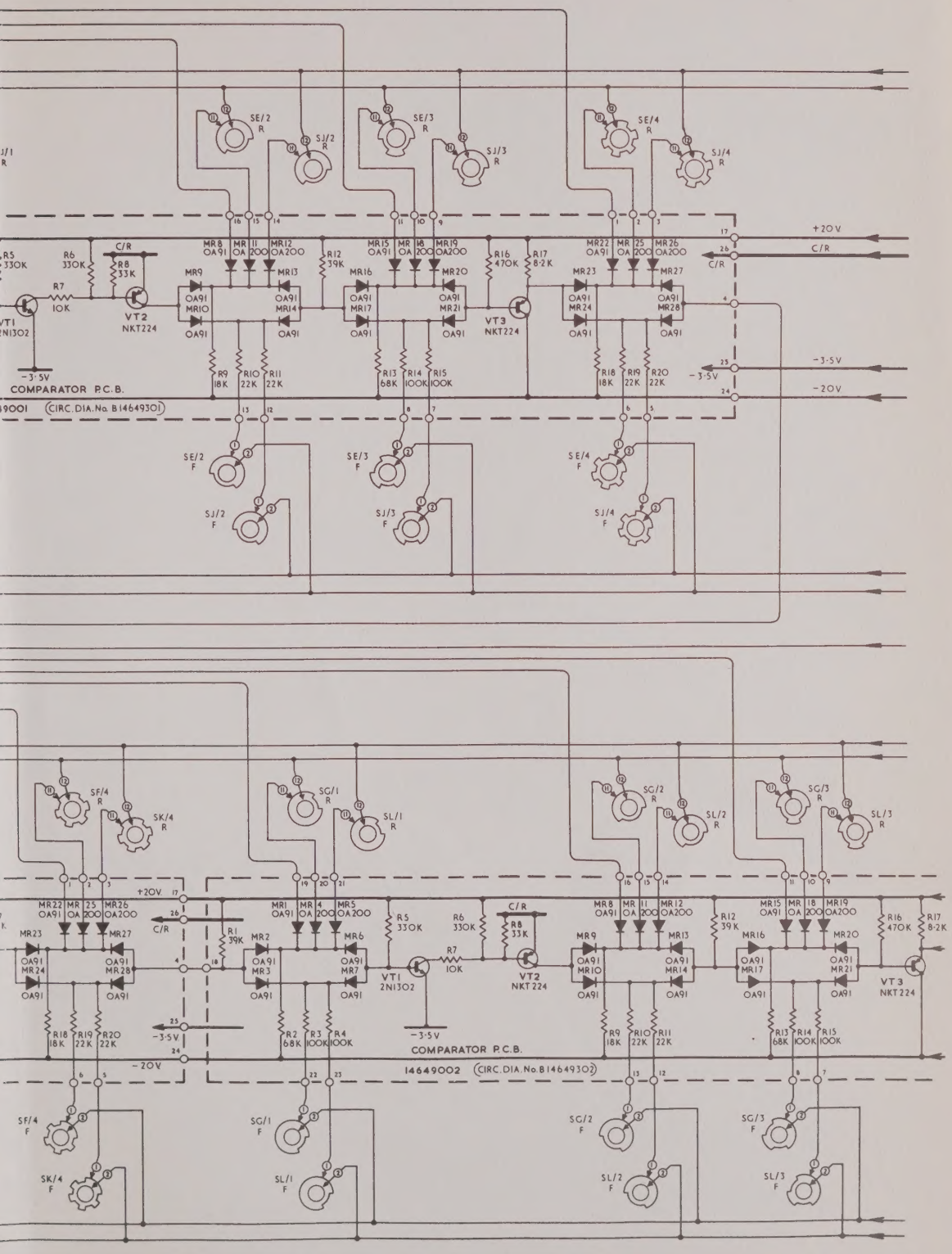
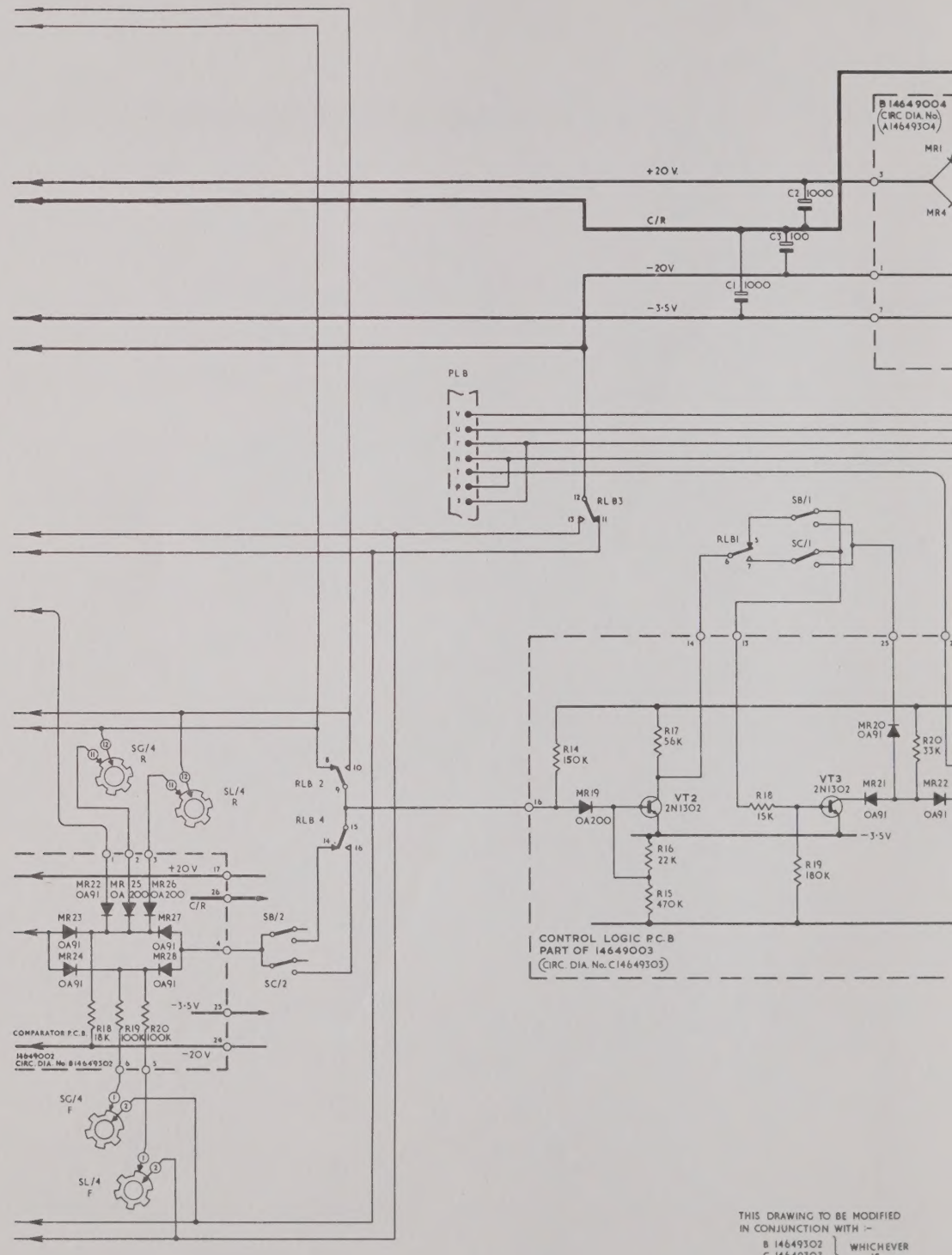


Diagram 10. Circuit Diagram Sheet 1.



THIS DRAWING TO BE MODIFIED
IN CONJUNCTION WITH :-

B 14649302
C 14649303
A 14649304
} WHICHEVER IS APPLICABLE

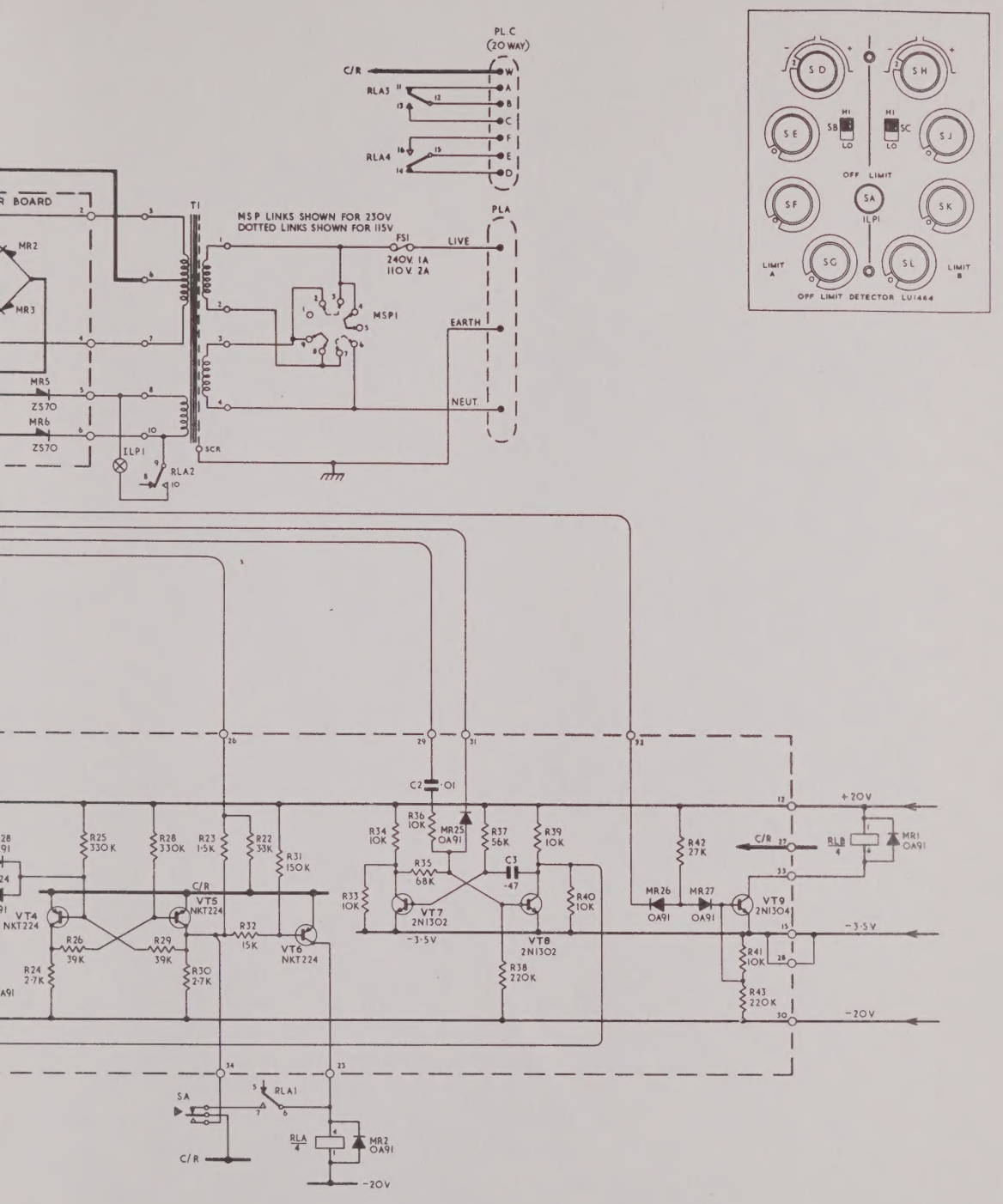


Diagram 11. Circuit Diagram Sheet 2.

MP MASTER
MA24418